



# pH Protocol



## **Purpose**

To measure pH

## **Overview**

The pH or acidity of the water sample is a key factor in determining what can live in the water.

## **Level**

All

## **Time**

5 minutes for the actual measurements  
10 to 15 minutes in class and 5 minutes in the field for calibration in Method 2

## **Frequency**

Weekly including calibration

## **Key Concepts**

- pH and its measurement
- Temperature affects pH
- Calibration
- pH buffers and standards

## **Skills**

- Using pH measuring equipment
- Recording data

## **Materials and Tools**

### **For Method 1:**

- pH indicator paper (Beginning)
- 50- or 100-mL beakers

### **For Method 2:**

- pH pen (Intermediate/Advanced)
- One jewelry screwdriver (for calibration)
- Three 50- or 100-mL beakers
- 50 mL polyethylene bottle with top or clean baby food jar with lid
- pH buffer solution for pH 7

or:

- pH meter (Intermediate/Advanced)
- Five 50- or 100-mL beakers
- Three 50-mL polyethylene bottles with tops or clean baby food jars with lid
- Three pH buffer solutions for pH 4, 7, and 10
- And for both pen and meter techniques:
  - 100 mL graduated cylinder
  - Paper towels
  - Soft tissues
  - Distilled water in a squeeze bottle
  - Stirring rod or spoon
  - Masking tape
  - Permanent marker
  - Latex gloves and safety goggles

## **Preparation**

Condition the pH pen or pH meter probes according to manufacturer's instructions. Remember to allow enough time (> one hour). Often pH pens and probes last longer if they are kept wet. Set up calibration buffer solutions of known pH in class. Calibrate the pen and meter before going to the water site. Bring the tools and materials to the water site, including the buffer solutions.

## **Prerequisites**

None

## Background

This Protocol involves determining the pH of the water sample from your Hydrology Study Site. We suggest that beginning level students use pH indicator paper, intermediate level students use a pH pen, and advanced level students use a pH meter.

## How To Measure pH

### Method 1: pH indicator paper

#### Beginning Level

1. Rinse a 50 mL or 100 mL beaker at least twice with sample water.
2. Fill the beaker about halfway with water to be tested.
3. Dip one strip of indicator paper into the sample water for at least a minute. Make sure all four segments of the paper are immersed in sample water.
4. Remove the paper from the water and compare the resultant four color segments with the chart on the back of the pH indicator paper box. Try to find a sequence where all four segments on the sample paper match all four segments on the box.
5. If reading is unclear, it may be because the paper needs more time to fully react. The indicator paper takes longer to react in water with conductivities below 400 microSiemens/cm. See the Electrical Conductivity Protocol. If this is the case, place the paper back into the sample for an additional minute, and check again. Repeat until satisfied that the reading is accurate. If the reading is still unclear after 10 minutes, start over with a new strip of pH paper. If the test fails a second time, make this clear on your Hydrology Investigation Data Work Sheet.
6. Read the corresponding pH and record this value on your Hydrology Investigation Data Work Sheet. Report this value to the GLOBE Student Data Server.

**Note:** pH paper readings may not be accurate if your water sample has an electrical conductivity below 300 microSiemens/cm (pH paper does not

function properly below this level). See the *Electrical Conductivity Protocol*.

### Method 2: pH pen or pH meter

#### Intermediate and Advanced Levels

In order to measure the pH of your water sample using the pH meter you need to: (1) prepare buffer solutions, (2) calibrate the instruments, (3) recheck your instrument by measuring the buffers in the field, and (4) measure the pH of your sample in the field.

#### Calibration Procedure

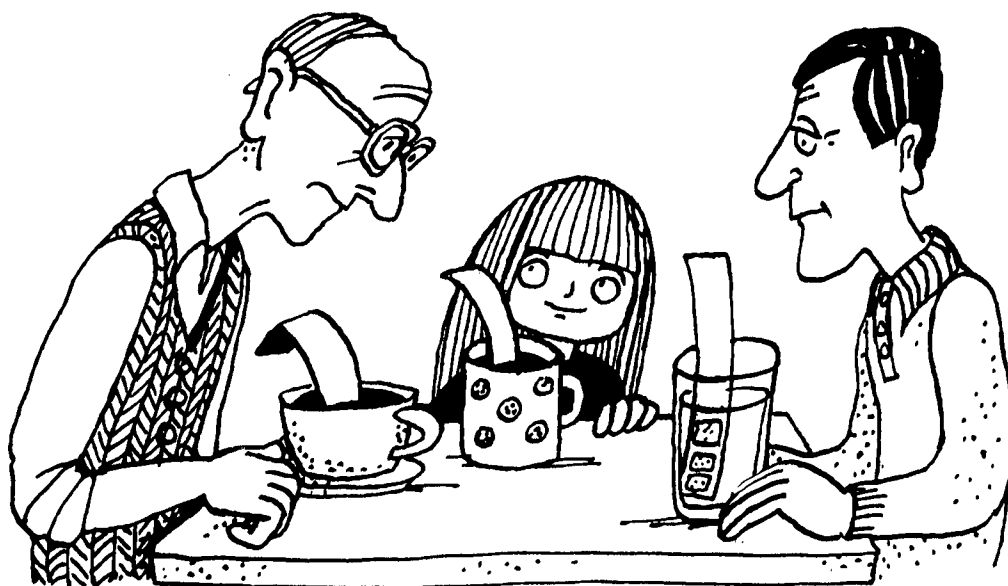
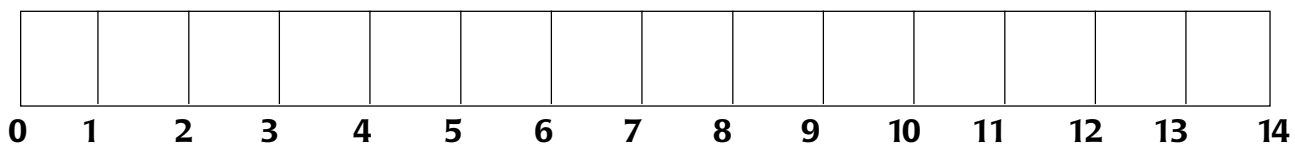
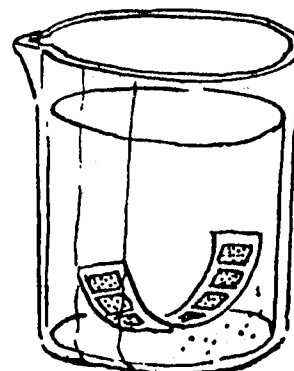
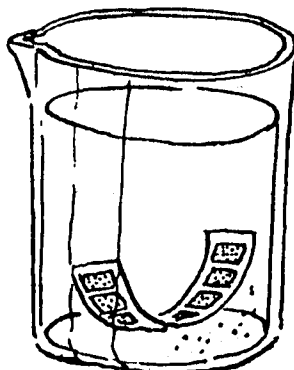
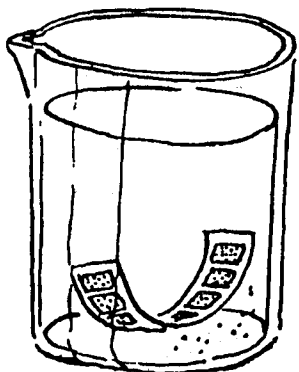
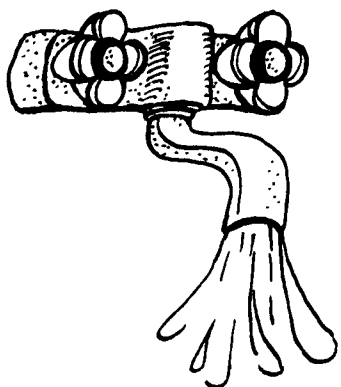
Calibration should be performed before each set of measurements. This procedure can be performed in the classroom before you go out in the field.

#### Step 1: Prepare the Buffer Solutions

Pre-mixed buffer solutions can be stored for 1 year, as long as they have not been contaminated. If you are using the powdered pillow buffer, then dissolve it in distilled water as described below. If you are using pre-mixed buffer solutions, measure 50 mL into a graduated cylinder and proceed to step 4.

#### For each pH buffer (4, 7, and 10):

1. Write the buffer pH and date on two pieces of masking tape. Place one on a clean, dry 100 mL beaker and the other on a 50 mL bottle or well cleaned baby food jar.
2. Using a graduated cylinder, measure 50 mL of distilled water and pour it into the beaker.
3. Over the beaker, completely cut open one end of a pillow of buffer powder, then squeeze and shake the pillow to release the powder into the water. Make sure all the powder is released into the water. Stir with stirring rod or spoon until all the powder dissolves.
4. Pour the buffer solution into the labeled bottle. Cap the bottle tightly. Discard after a month.
5. Continue preparing the other buffers, repeating steps 1-4 for each.



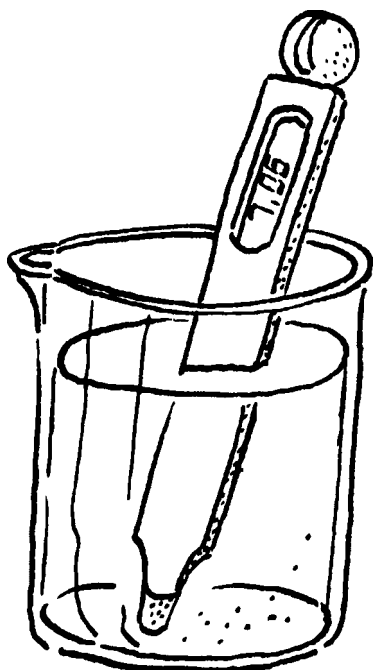
Source: Jan Smolik, 1996, TEREZA, Association for Environmental Education, Czech Republic

## Step 2: Calibrate the pH pen or meter

### A. Calibration of the pH pen

**Note:** If the pH pen does not have automatic temperature compensation, the buffer solution should be at 25° C.

1. Condition the electrode as described by the manufacturer.
2. Rinse the electrode (glass probe) and area around it twice with distilled water using a squeeze bottle and blot dry with a soft tissue after each rinse. Rinse into a discard beaker or sink, not into the pH buffer solution and do not touch the electrode (glass probe) with your fingers.
3. Turn the pen on with the switch on top, then immerse the electrode entirely in the pH 7.0 buffer solution. See Figure HYD-P-3.
4. Gently stir the buffer solution with the probe and wait for the reading to stabilize.
5. Use a jewelry screwdriver to turn the small screw in the hole in the back of the pen until the reading is exactly 7.0.
6. Remove the pH pen from the solution and rinse the electrode with distilled water; pour the buffer solution back into its labeled bottle and seal tightly.



### B. Calibration of the pH meter

1. Condition the electrode (probe) as described in the manufacturer's instructions.
2. Rinse the electrode (glass probe) and area around it twice with distilled water using a squeeze bottle and blot dry with a soft tissue after each rinse. Rinse into a discard beaker or sink, not into the pH buffer solution and do not touch the electrode (glass probe) with your fingers.
3. Turn the meter on (by pressing the ON/OFF button). Push the CAL button to indicate that you will be calibrating the instrument.
4. Immerse the electrode in the pH 7.0 buffer solution, making sure that the electrode is entirely immersed. Do not immerse the instrument further than is necessary. See Figure HYD-P-3.
5. Gently stir the buffer solution with the electrode and wait for the display value to stabilize. Once the reading has stabilized, press the HOLD/CON button to accept the value and complete the calibration. If the electrode is still immersed in the buffer, the



Source: Jan Smolik, 1996, TEREZA, Association for Environmental Education, Czech Republic



display will read the same value as the pH of the buffer (i.e. 4, 7, or 10).

6. Remove the pH tester from the buffer solution, rinse the electrode with distilled water, and blot dry with soft tissue.
7. Repeat steps 3 through 6 using the pH 4 buffer and then using the pH 10 buffer.
8. Set the tester aside on a paper towel; turn the meter off by pushing the ON/OFF button.
9. Pour the buffer solution into their labeled bottles and cap them tightly.

### Step 3: Recheck your pH pen or meter in the Field

1. Take the pH buffer solutions into the field with you. Treat them as samples. Test the pH of the buffer solutions and record the field pH buffer values on the data sheets. If the values of the buffer solutions are more than + or - 0.2 pH units from the true value, go through the instrument calibration procedure again.
2. After you have tested the pen or meter with the buffer solutions, you are ready to measure the pH of the actual water sample.

### pH Measurement Procedure

1. Rinse the electrode and the surrounding area with distilled water using the squeeze bottle. Blot the area dry with a soft tissue.
2. Fill a clean, dry 100 mL beaker to the 50 mL line with the water to be tested.
3. Immerse the electrode in the water. Be sure that the entire electrode is immersed, but avoid immersing it any further than necessary.
4. Stir once and then let the display value stabilize.
5. Once the display value is stable, read the pH value and record it in the Hydrology Investigation Data Work Sheet.
6. Repeat steps 1 through 5 for another sample as a quality control check. The two pH values should agree to within 0.2 which is the accuracy of this technique.
7. Rinse the probe with distilled water, blot it dry with soft tissue, replace the cap on the probe, and turn the instrument off.

8. Take the average of pH values measured by the student groups. If the recorded values are all within 0.2 of the average, report the average value to the GLOBE Student Data Server. If there is one outlier (a value far different from the rest) discard that value and calculate the average of the other values. If they are all now within 0.2 of this new average, report this new average to the GLOBE Student Data Server. If there is a wide scatter in results, discuss the procedure and the potential sources of error with the students, but do not report a value to the Data Server. Repeat the protocol if possible to produce a reportable measurement.

**Note:** pH pen or meter readings may not be accurate if your water sample has a conductivity below 100 microSiemens/cm (pH pens and meters do not function properly below this level). See the *Electrical Conductivity Protocol*.

Figure HYD-P-3: Using the pH pen

